BENTHIC MACROINVERTEBRATE STUDY OF HONEY BRANCH, ITS SEDIMENT CONTROL PONDS, AND ITS INFLUENCE ON THE EAST FORK OF TWELVEPOLE CREEK CONDUCTED 10/08/99

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INTRODUCTION

One of the first permitted valley fills in West Virginia was located on Honey Branch. Honey Branch is a first-order tributary of the East Fork of Twelvepole Creek in Lincoln County, in southwestern West Virginia. Contour surface mining activities began in 1987, and were completed in 1991. On going reclamation activities were performed during mining operations. The Honey Branch mining site received its Phase II bond reclamation last year.

In June 1987 Heer, Inc. performed a benthic macroinvertebrate survey to provide a biological assessment of Honey Branch prior to mining activities to satisfy requirements for permit application. In July 1987 the West Virginia Department of Environmental Protection (WV-DEP) performed an informal, qualitative biological survey to confirm the assessments of the stream prior to mining operations. Science Applications International Corporation (SAIC) conducted another survey of Honey Branch in June 1998 to assess the impacts of mining activities and valley fills on the Honey Branch waterway. Several sites sampled during the Heer, Inc. survey were able to be utilized during the SAIC study for direct comparisons to be accurately made. Other sites were not possible to be sampled because they had been completely covered by the construction of valley fills. This study, performed in October 1999 was conducted to verify the present conditions of Honey Branch since mining activities has long since ceased in the area, and to determine if Honey Branch has had any effect on its receiving stream, the East Fork of Twelvepole Creek. Another purpose for the current study came about as a response to the environmental protests on the initial permit submittion. Many of the identical stations which were sampled during previous studies were sampled for this study so that comparisons could be made between the studies, and so that inferences as to macroinvertebrate community trends could be evaluated.

Another purpose of this study was to provide an unbiased, professional examination of the sediment control ponds and sediment ditches which currently exist on Honey Branch. These would be studied as to their aquatic and wetland status, as well as their usefulness as quality habitats for fauna inhabiting the area. Because Pen Coal has acquired the property, the ponds and sediment ditches on Honey Branch are now considered to be permanent structures. Normally, according to the West Virginia Department of Environmental Protection-Office of Mining and Reclamation, upon completion

of mining activities, constructed sediment control ponds and/or drainage ditches must be removed prior to being released from permitting regulations if they are considered as temporary structures. Breaching of the dam is therefore required from the point of view that in order to return the stream back to its original state, the stream channel must be change back to its original shape.

Policies within the West Virginia Department of Environmental Protection (WV-DEP) require biological surveys of streams prior to, and after issuance of National Pollutant Discharge Elimination System (NPDES) permits to adequately determine stream biota and potential biological development. Biological data, such as aquatic macroinvertebrate populations, in conjunction with physical and chemical water quality, and habitat data, provide valuable information that are used in the permit review process and are ultimately used to assist in establishing NPDES discharge limitations. These data also act as a powerful monitoring tool in identifying possible pollutant sources and/or habitat alterations and subsequent effects.

LOCATION OF STUDY SITES

The study area is located in Lincoln County approximately 3/4 mile north of the Mingo/Lincoln County line in southwest West Virginia. Honey Branch is a first-order tributary of the East Fork of Twelvepole Creek. The Honey Branch waterway extends approximately 1,500 feet and has a watershed area of approximately 609 acres. The forks of Honey Branch begin at an elevation of approximately 1,100 feet above sea level the stream travels northward to enter the East Fork of Twelvepole Creek at an elevation of approximately 750 feet above sea level.

Three stations were sampled on Honey Branch, at the toe of the primary valley fill, mid-way between the toe and the mouth of Honey Branch, and at the mouth of Honey Branch. Two stations were sampled on the East Fork of Twelvepole Creek, upstream from the confluence with Honey Branch, and downstream from the confluence with Honey Branch. The middle Honey Branch sediment control pond (Pond Number 2), the lower Honey Branch sediment control pond (Pond Number 1), and the sediment ditch on Honey Branch were also sampled.

METHODS OF INVESTIGATION

On October 08, 1999 measurements for flow, physical water quality, and chemical water quality were taken at each of the stream, pond, and sediment ditch stations. Benthic macroinvertebrate samples were also collected, and the habitat of the stations was evaluated. The individual methodologies are described below.

Physical Water Quality

Physical water quality was analyzed on-site at each station. Water temperature, Dissolved Oxygen (DO), pH, and conductivity was measured with a Hydrolab™ Minisonde multi-parameter probe. Flow was measured in the streams with a Marsh-McBirney™ Model 2000 portable flow meter. Stream widths, depths, and velocities were measured, and the resulting average discharge was reported for each station.

Water Chemistry

Water chemistry samples were collected at each station and returned to R.E.I. Consultants, Inc. for processing. Parameters analyzed included acidity, alkalinity, chloride, hardness, sulfate, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), fecal coliform, aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, sodium, thallium, and zinc.

Habitat

For the stream stations, habitat was assessed and rated on nine parameters in three categories using EPA's Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA 440/4-89/001). For the pond and sediment ditch sites, habitat was described as to its quality for fish, macroinvertebrates, and wildlife by assessing the size, shape, sediment storage potential, substrate type, bank stability, and vegetation types.

Benthic Macroinvertebrates

A modified EPA Rapid Bioassessment Protocol III (EPA 440/4-89/001) was utilized in the collection of the benthic macroinvertebrate specimens. At each stream station, collections were made via an Ellis-Rutter™ Portable Invertebrate Box Sampler (PIBS) sampler fitted with a 350-?m mesh size net. The PIBS sampler has several advantages over the standard Surber™ sampler which makes it a desirable choice for the collection of aquatic macroinvertebrates. Sampler area was 0.10 m^2 per replicate. Two samples were taken in a faster flowing riffle area and a third in a slower run area at each station. A kick-net seine was also utilized at each station, but in a slower run/pool area. The kick-net was fitted with a 500-?m mesh size net, and sampled approximately a 1-m^2 area per replicate. For the

pond and sediment ditch sites, collections were made via a Ponar grab sampler. The Ponar grab sampler has several features which make it a desirable choice for the collection of aquatic macroinvertebrates in lentic habitats such as ponds, lakes, as well as lotic deepwater habitats such as rivers. Sampler area was 81 $inch^2$ per replicate. Three samples were taken near the shoreline, and in the best available spots (lowest siltation, highest percentage of gravel/pebble substrate, highest vegetation) at each station.

Samples were placed in 1-l plastic containers, preserved in 35% formalin, and returned to the laboratory for processing. Samples were then picked under Unitron™ microscopes and detrital material was discarded only after a second check to insure that no macroinvertebrates had been missed. All macroinvertebrates were identified to lowest practical taxonomic level and enumerated. Several benthic macroinvertebrate metrics were then calculated for each station.

SPECIFIC STATION LOCATIONS / PHYSICAL DESCRIPTIONS

Upstream Honey Branch Station (Toe of Valley Fill)

This station was located on Honey Branch approximately 70 feet downstream from the toe of the primary valley fill (Photographs 1 - 2). This station corresponded to the same location which was sampled during the SAIC 1998 study. Where the benthic samples were collected the substrate was comprised of approximately 50% bedrock, 25% cobble, 20% gravel, and 5% sand and silt. Average stream width was approximately 3 feet. Average depth was approximately 3 inches where the physical water quality was measured. Average flow was 0.15 cubic feet/second. In-the-field water quality measurements (Table 1A) were as follows: water temperature 13.36?C, Dissolved Oxygen (DO) 6.82 mg/l, pH 6.60, conductivity 400 ?mhos. A very desirable amount of Coarse Particulate Organic Matter (CPOM) was present in the form of shredded and whole leaves, sticks, and some large woody debris increasing both the available substrate and the foodbase. The stream contained a fairly desirable ratio of pools, runs, and riffles. The deciduous forest canopy was partly shaded due to the fairly dense forest surrounding the stream. Surrounding vegetation consisted mostly of the trees. Streambanks were very well vegetated, but were steep and appeared to be moderately unstable.

Middle Honey Branch Station

This station (Photographs 3 - 4) was located on Honey Branch below the middle Honey Branch pond (Pond Number 2). This station corresponded to the same location which was sampled during the SAIC 1998 study. Where the benthic samples were collected the substrate was comprised of approximately 25% cobble, 50% gravel, and 25% sand and silt. Average stream width was approximately 3 feet. Average depth was approximately 3 inches where the physical water quality was measured. Average flow was 0.08 cubic feet/second. In-the-field water quality measurements (Table 1A) were as follows: water temperature 14.41?C, Dissolved Oxygen (DO) 7.74 mg/l, pH 7.91, conductivity 367 ?mhos. There was a moderate amount of Coarse Particulate Organic Matter (CPOM) which was present in the form of shredded and whole leaves increasing both the available substrate and the foodbase. The stream contained a fairly desirable ratio of pools, runs, and riffles. The deciduous forest canopy was open because the surrounding forest was farther from the stream at this location. Surrounding vegetation consisted mostly of grasses and other herbaceous vegetation. Streambanks were very well vegetated, and were not steep and appeared to be very stable.

Mouth of Honey Branch

This station was located at the mouth of Honey Branch before it entered the East Fork of Twelvepole Creek. This station also corresponded to the same location which was sampled during the SAIC 1998 study. Where the benthic samples were collected the substrate was comprised of approximately 5% boulder, 55% cobble, 30% gravel, 5% sand, and 5% silt. Average stream width was approximately 2.5 feet. Average depth was approximately 2 inches where the physical water quality was measured. Average flow was 0.11 cubic feet/second.

In-the-field water quality measurements (Table 1A) were as follows: water temperature 16.29?C, Dissolved Oxygen (DO) 6.64 mg/l, pH 7.92, conductivity 348 ? mhos. There was a very desirable amount of Coarse Particulate Organic Matter (CPOM) which was present in the form of shredded and whole leaves, sticks, and larger woody debris increasing both the available substrate and the foodbase. The stream contained a fairly desirable ratio of pools, runs, and riffles. The deciduous forest canopy was shaded due to the dense surrounding forest at this location. Surrounding vegetation consisted mostly of trees, but shrubs, grasses and other herbaceous vegetation was also present. Streambanks were moderately well vegetated, were somewhat steep, and appeared to be moderately stable.

Upstream East Fork of Twelvepole Creek

This station was located on Twelvepole Creek approximately 100 feet upstream from the confluence with Honey Branch. This station corresponded to the same location which was sampled during the SAIC 1998 study. Where the benthic samples were collected the substrate was comprised of approximately 40% cobble, 50% gravel, 5% sand, and 5% silt. Average stream width was approximately 25 feet. Average depth was approximately 4 inches where the physical water quality was measured. Average flow was 0.11 cubic feet/second. In-the-field water quality measurements (Table 1A) were as follows: water temperature 13.88?C, Dissolved Oxygen (DO) 4.69 mg/l, pH 7.16, conductivity 159 ? mhos. There was a desirable amount of Coarse Particulate Organic Matter (CPOM) which was present mainly in the form of shredded and whole leaves increasing both the available substrate and the foodbase. The stream was comprised mostly of large pools and runs; riffle areas were scarce at this location. The deciduous forest canopy was partly shaded at this location. Surrounding vegetation consisted mostly of trees, but grasses and other herbaceous vegetation was also along the streambanks. Streambanks were moderately well vegetated, were undercut at places, but appeared to be moderately stable.

Downstream East Fork of Twelvepole Creek

This station was located on Twelvepole Creek approximately 100 feet downstream from the confluence with Honey Branch. Where the benthic samples were collected the substrate was comprised of approximately 5% boulder, 30% cobble, 50% gravel, 10% sand, and 5% silt. Average stream width was approximately 20 feet. Average depth was approximately 4 inches where the physical water quality was measured. Average flow was 0.21 cubic feet/second. In-the-field water quality measurements (Table 1A) were as follows: water temperature 14.77?C, Dissolved Oxygen (DO) 6.56 mg/l, pH 7.50, conductivity 212 ? mhos. There was a desirable amount of Coarse Particulate Organic Matter (CPOM) which was present mainly in the form of shredded and whole leaves increasing both the available substrate and the foodbase. The stream was comprised of a fairly good ratio of pools, runs, and riffle areas at this location. The deciduous forest canopy was partly shaded at this location. Surrounding vegetation consisted mostly of trees, but grasses and other herbaceous vegetation was also along the streambanks. Streambanks were moderately well vegetated, were undercut at

places, but appeared to be moderately stable.

Honey Branch's Middle Pond (Pond Number 2)

This station was located on Honey Branch, and was constructed in 1988 (Photograph 5). The pond has an area of approximately 0.53 acres. The existing water depth was about 4 feet. Due to the pond being over 10 years old, the banks were 100% vegetated, and this was with various grasses, rushes, sweet flag, woolgrass, golden rod, greenbrier, and alders. Aquatic vegetation was comprised of milfoil (Myriofyllum sp.), pondweed (Potamogeton sp.), and cattails. Fish were present, but not positively identified to species. The banks were not steep along one side, but were stable due to their overall steepness, heavy vegetation, and established soil properties. No signs of erosion were present. There was some pond cover present due to the closer distance from the surrounding deciduous forest, and from the heavy vegetation surrounding the shoreline areas. The substrate was comprised mostly of silt with large abundances of detrital material (Table 4B).

Honey Branch's Lower Pond (Pond Number 1)

This station was located on Honey Branch, and was also constructed in 1988 (Photograph 6). This large pond is approximately 500 feet in length, and is approximately 300 feet wide, and has an area of approximately 1.01 acres. The elevation of the pond's bottom is approximately 780 feet above sea level. The existing water depth was about 6 feet. Due to the pond being over 10 years old, the banks were 100% vegetated, and this was with various grasses, rushes, sedges, sweet flag, woolgrass, golden rod, greenbrier, alders, and willows. Aquatic vegetation was comprised of cattails. Fish and bullfrogs were present, but were not positively identified to species. The banks were only steep along one side, but were stable due to their heavy vegetation, and well established soils. No signs of erosion were present. There was some pond cover present due to the close distance from the surrounding deciduous forest, and from the heavy vegetation surrounding the shoreline areas. The substrate was comprised mostly of silt with very large abundances of detrital material (Table 4B).

Honey Branch Sediment Ditch

This station was located on Honey Branch, and was constructed in 1988 (Photographs 7 - 8). The sediment ditch is approximately 100 feet in length, is approximately 20 feet wide, and has an area of approximately 0.05 acres. The existing water depth was only about a foot. Because the sediment ditch was constructed over ten years ago, the banks were very well vegetated with grasses, sedges, autumn olive, alder, scarlet maple, and box elder. Aquatic vegetation consisted primarily of cattails. The banks were not too steep along the hillsides, and were noticeably stable due to their low gradient and heavy vegetation. Soils were very well established due to the older age of this structure. This sediment ditch had noticeably lower dissolved oxygen levels (Table 1B) probably due to the heavy organic loading at this site. There was some canopy cover present due to the young trees growing and from the surrounding cattails. The substrate was comprised almost entirely of heavily organic and

detrital materials (Table 4B).

PHYSICAL AND CHEMICAL WATER QUALITY ANALYSIS

Physical and chemical water quality was analyzed at each of the three stations sampled on Honey Branch, the two stations sampled on the East Fork of Twelvepole Creek, two of the sediment ponds on Honey Branch, and in Honey Branch's sediment ditch (Figure 1). The physical and chemical water quality results are presented in Tables 1A and 1B. Most values determined in Honey Branch were fairly similar with desirable DO levels, adequate pH levels, desirable alkalinity, low acidity, and low concentrations of metals. However, the dissolved solids, hardness, and sulfates were elevated, but were not considered limiting. Of the stations on the East Fork of Twelvepole Creek, most values were similar and desirable with near neutral pH levels, lower conductivity, lower hardness and alkalinity, and lower solids than for the stations on Honey Branch. The downstream East Fork station had higher levels of most parameters compared to the upstream East Fork station, but this was entirely due to the influence of Honey Branch. No values on the East Fork of Twelvepole Creek were considered limiting to the aquatic fauna as each station contained many individuals comprised of several taxa which are sensitive to pollutants.

For the Honey Branch sediment ponds and sediment ditch, most of the chemical values such as dissolved solids, hardness, sulfates, alkalinity, and most metals were very similar to those determined in the main channel of Honey Branch. Although several of these values were considered elevated, none were considered too limiting to the aquatic fauna, and it should be remembered that one of the primary purposes of the ponds and sediment ditches is for reducing the high levels of solids and metals by settling them out prior to reaching the downstream portions of the receiving streams.

Based on these data, Honey Branch can be classified as a moderate fertility, high buffering capacity, hard-water stream within the areas sampled; the East Fork of Twelvepole Creek can be classified as moderate fertility, moderate buffering capacity, hard-water stream within the areas sampled.

HABITAT ASSESSMENT

Stream Parameters

Several habitat measurements were calculated (Table 4A) for each of the stations sampled on Honey Branch and the East Fork of Twelvepole Creek. The individual parameters are described below.

Parameter 1. Bottom Substrate - The availability of habitat for support of aquatic organisms. A variety of substrate materials and habitat types is desirable. The bottom substrate is evaluated and rated by observation.

Parameter 2. Embeddedness - The degree to which boulders, rubble, or gravel are surrounded by fine sediment indicates suitability of the stream substrate as habitat for benthic macroinvertebrates as well as for fish spawning and egg incubation. Embeddedness is evaluated by visual observation of the degree to which larger particles are surrounded by sediment.

Parameter 3. Stream Flow - Stream flow relates to the ability of a stream to provide and maintain a stable aquatic environment.

Parameter 4. Channel Alteration - The character of sediment deposits from upstream is an indication of the severity of watershed and bank erosion and stability of the stream system. Channelization decreases stream sinuosity, thereby increasing stream velocity and the potential for scouring.

Parameter 5. Bottom Scouring and Deposition - These parameters relate to the destruction of instream habitat resulting from channel alterations. Deposition and scouring is rated by estimating the percentage of an evaluated reach that is scoured or silted.

Parameter 6. Pool/Riffle or Run/Bend Ratio - These parameters assume that a stream with riffles or bends provides more diverse habitat than a straight or uniform depth stream. The ratio is calculated by dividing the average distance between riffles or bends by the average stream width.

Parameter 7. Bank Stability - Bank stability is rated by observing existing or potential detachment of soil from the upper and lower stream bank and its potential movement into the stream. Streams with poor banks will often have poor instream habitat.

Parameter 8. Bank Vegetative Stability - Bank soil is generally held in place by plant root systems. An estimate of the density of bank vegetation covering the bank provides an indication of bank stability and potential instream sedimentation.

Parameter 9. Streamside Cover - Streamside cover vegetation is evaluated in terms of provision of stream-shading and escape cover for fish. A rating is obtained by visually determining the dominant vegetation type covering the exposed stream bottom, bank, and top of bank. Riparian vegetation dominated by shrubs and trees provides the CPOM source in allochthonous systems.

Sediment Pond and Sediment Ditch Measurements

Several habitat measurements were also determined (Table 4B) at each of the Honey Branch pond and sediment ditch sites sampled. The individual parameters are described below.

Pond/Ditch Surface Acreage - Actual size of the structure in acres. Smaller, shallower ponds and ditches, may not last as long or have as much sediment holding potential, but they will have a larger wetland value as there is less open water and more wetland vegetated area.

Length x Width - Longer, narrower ponds and sediment ditches will eventually have better wetland values for filtering incoming waters and provide more useable habitat for aquatic insects than wider, deeper ponds and sediment ditches.

Accumulative Sediment Storage Potential - Amount of sediment the structure can potentially hold. Larger, deeper ponds and sediment ditches can obviously hold more sediments, but may not have as desirable "wetland" potential.

Bottom Substrate Type - The availability of habitat for support of aquatic organisms. A variety of substrate materials and habitat types is desirable. Substrates comprised of more gravel, pebble, and/or organic materials are more desirable than those comprised mostly of silt and clay.

Bank Stability - Bank stability is rated by observing existing or potential detachment of soil from the upper and lower banks and its potential movement into the structure. Ponds and ditches with poor banks will often have poor instream habitat.

Bank Vegetative Stability - Bank soil is generally held in place by plant root systems. An estimate of the density of bank vegetation covering the bank provides an indication of bank stability and potential instream sedimentation.

Vegetation Type - Describes the vegetation type present. Newer structure will likely have only grasses planted along banks. Older structures can have grasses, several herbaceous species, as well as shrubs and tree saplings. Wetland vegetation on newer structures may not be present, but can consist of several types of algae, submerged and emergent aquatic species at older, more established structure.

Pond/Ditch Cover - Cover vegetation is evaluated in terms of provision of shading and escape cover for fish. A rating is obtained by visually determining the dominant vegetation type covering the exposed pond bottom, bank, and top of bank. Riparian vegetation dominated by shrubs and trees provides the CPOM source in allochthonous systems.

HABITAT RESULTS

Upstream Honey Branch Station (Toe of Valley Fill)

This station received excellent substrate and instream cover (primary) ratings, good to excellent channel morphology (secondary) ratings, and fair to excellent riparian and bank structure (tertiary) ratings. Overall, this upstream station on Honey Branch contained more than adequate food sources, flows, excellent habitat and cover, but was slightly limited by bank stability and the lack of deeper pools (Table 4A).

Middle Honey Branch Station

This station received excellent substrate and instream cover (primary) ratings, good to excellent channel morphology (secondary) ratings, and fair to excellent riparian and bank structure (tertiary) ratings. Overall, this station on Honey Branch contained adequate food sources, fine flows, good cover and bank stability, but was limited by the lack of better streamside cover and deeper pools (Table 4A).

Downstream Honey Branch (Mouth of Honey Branch)

This station received good to excellent substrate and instream cover (primary) ratings, good to excellent channel morphology (secondary) ratings, and good riparian and bank structure (tertiary) ratings. Overall, this station located at the mouth of Honey Branch contained adequate food sources, but was limited by deposition, bank stability, and streamside cover (Table 4A).

Upstream East Fork of Twelvepole Creek

This station received fair to excellent substrate and instream cover (primary) ratings, fair to excellent channel morphology (secondary) ratings, and good riparian and bank structure (tertiary) ratings. Overall, this station above the confluence with Honey Branch contained good habitat and adequate food sources, but was severely limited by the lack of riffle areas, bank stability, and the lack of adequate streamside cover (Table 4A).

Downstream East Fork of Twelvepole Creek

This station received excellent substrate and instream cover (primary) ratings, good to excellent channel morphology (secondary) ratings, and good riparian and bank structure (tertiary) ratings. Overall, this station below the confluence with Honey Branch contained good habitat and adequate food sources, but was limited by deposition, bank stability, and the lack of adequate streamside cover (Table 4A).

Honey Branch's Middle Pond (Number 2)

This pond had a surface area of 0.53 acres and was approximately 150 feet long by 150 feet wide (Table 4B). Because it was completed many few years ago in 1988, banks were 100% vegetated, and with grasses, herbaceous plants, shrubs, saplings, and larger trees. The

substrate was silty, detrital material. This structure has fairly good storage potential, and it should serve well as a sediment control pond. Because banks are stable, this structure will most likely remain an open water pond for quite some time. This structure has good wetland potential, and due to its larger size, may serve very well for waterfowl, fish, and amphibians.

Honey Branch's Lower Pond (Number 1)

This pond had a surface area of 1.01 acres, and was approximately 500 feet long by 300 feet wide (Table 4B). Because it was completed many few years ago in 1988, banks were 100% vegetated, and with grasses, herbaceous plants, shrubs, saplings, and larger trees. The substrate was silty, detrital material. This structure has fairly good storage potential, and it should serve well as a sediment control pond. Because banks are fairly stable, this structure will most likely remain an open water pond for quite some time. This structure has tremendous wetland potential, and due to its large size, should serve very well for waterfowl, fish, and amphibians. In addition, due to its placement and surrounding settings, this structure has a very high aesthetic value.

Honey Branch Sediment Ditch

This sediment ditch had a surface area of 0.05 acres, and was approximately 100 feet long by 20 feet wide (Table 4B). Because it was completed many few years ago in 1988, banks were 100% vegetated, and with grasses, herbaceous plants, shrubs, saplings, and larger trees. The substrate was heavily organic, detrital material. This structure has some storage potential, but appears to be close to reaching its full potential. This structure has good wetland potential, even though it was small in size.

DESCRIPTION OF BENTHIC MACROINVERTEBRATE METRICS

Several benthic macroinvertebrate measurements were calculated (Tables 3A and 3B) for each of the stations sampled on Honey Branch, the East Fork of Twelvepole Creek, the Honey Branch sediment ponds and the sediment ditch on Honey Branch. The individual metrics are described below.

Metric 1. Taxa Richness - Reflects the health of the community through a measurement of the variety of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability. However, the majority should be distributed in the pollution sensitive groups, a lesser amount in the facultative groups, and the least amount in the tolerant groups. Polluted streams shift to tolerant dominated communities.

Metric 2. Modified Hilsenhoff Biotic Index - This index was developed by Hilsenhoff (1987) to summarize overall pollution tolerance of the benthic arthropod community with a single value. Calculated by summarizing the number in a given taxa multiplied by its tolerance value, then divided by the total number of organisms in the sample.

Metric 3. Ratio of Scraper and Filtering Collector Functional Feeding Groups - This ratio reflects the riffle/run community foodbase and provides insight into the nature of potential disturbance factors. The relative abundance of scrapers and filtering collectors indicate the periphyton community composition, availability of suspended Fine Particulate Organic Material (FPOM) and availability of attachment sites for filtering. Filtering collectors are sensitive to toxicants bound to fine particles and should be the first group to decrease when exposed to steady sources of bound toxicants.

Metric 4. Ratio of Ephemeroptera, Plecoptera, Trichoptera (EPT) and Chironomidae Abundances - This metric uses relative abundance of these indicator groups as a measure of community balance. Good biotic condition is reflected in communities having a fairly even distribution among all four major groups and with substantial representation in the sensitive groups Ephemeroptera, Plecoptera, and Trichoptera. Skewed populations with large amounts of Chironomidae in relation to the EPT indicates environmental stress.

Metric 5. Percent Contribution of Dominant Family - This is also a measure of community balance. A community dominated by relatively few species would indicate environmental stress. A healthy community is dominated by pollution sensitive representation in the Ephemeroptera, Plecoptera, and Trichoptera groups.

Metric 6. EPT Index - This index is the total number of distinct taxa within the Orders: Ephemeroptera, Plecoptera, and Trichoptera. The EPT Index generally increases with increasing water quality. The EPT index summarizes the taxa richness within the pollution sensitive insect orders.

Metric 7. Ratio of Shredder Functional Feeding Group and Total Number of Individuals Collected - Allows evaluation of potential impairment as indicated by the shredder community. Shredders are good indicators of riparian zone impacts.

Metric 8. Simpson's Diversity Index - This index ranges from 0 (low diversity) to almost 1 (high diversity). A healthy benthic macroinvertebrate community should have a higher Simpson's Diversity Index.

Metric 9. Shannon-Wiener Diversity Index - Measures the amount of order in the community by using the number of species and the number of individuals in each species. The value increases with the number of species in the community. A healthy benthic macroinvertebrate community should have a higher Shannon-Wiener Diversity Index.

Metric 10. Shannon-Wiener Evenness - Measures the evenness, or equitability of the community by scaling one of the heterogeneity measures relative to its maximal value when each species in the sample is represented by the same number of individuals. Ranges from 0 (low equitability) to 1 (high equitability).

BENTHIC MACROINVERTEBRATE RESULTS

Upstream Honey Branch Station (Toe of Valley Fill)

A total of 626 individuals comprising 22 taxa were collected (Tables 2A and 5). Five pollution sensitive (intolerant) taxa comprising 6.9% of the station's abundance were present. The sensitive mayfly Leptophlebia (Family: Leptophlebiidae) contributed 5.4% to the total abundance at this upstream station. Nine facultative (intermediate tolerance) taxa were present comprising 7.2% of the station's total abundance. The facultative springtail Collembola contributed 3.4% to the total abundance. Eight tolerant taxa were present comprising 85.9% of the abundance at this station. The tolerant aquatic worm, Oligochaeta, accounted for 51.1% of the total abundance, and was the most abundant taxa present at this station on Honey Branch. Ten EPT groups (Table 3A) were present which aided the EPT:Chironomidae Index in being fairly desirable. All functional feeding groups were present and were fairly well represented at this station. A very wide variety of stoneflies and caddisflies were collected at this station; mayflies were less abundant. The Simpson's and Shannon-Wiener Diversity indices reflected a moderately diverse community; the Shannon-Wiener Evenness value of 0.52 indicated that abundances were only moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a moderately healthy, but pollution tolerant macroinvertebrate community with a fairly good periphyton community composition.

Middle Honey Branch Station

A total of 558 individuals comprising 21 taxa were collected (Tables 2A and 6). Five pollution sensitive (intolerant) taxa comprising 18.3% of the station's abundance were present. The sensitive beetle Family: Elmidae contributed 14.0% to the total abundance at this Honey Branch station. Eight facultative (intermediate tolerance) taxa were present comprising 22.9% of the sample. The facultative stonefly Leuctra (Family: Leuctridae) contributed 10.0% to the total abundance. Eight tolerant taxa were present comprising 58.8% of the abundance at this station. Again, the tolerant aquatic worm, Oligochaeta, accounted for 30.0% of the total abundance, and was the most abundant taxa at this station on Honey Branch. Eight EPT groups (Table 3A) were present which contributed to the EPT:Chironomidae Index in being very desirable. All functional feeding groups were present and were very well represented. A wide variety of stoneflies and caddisflies were collected at this station; mayfly population was again low. The Simpson's and Shannon-Wiener Diversity indices reflected a very diverse community, and the Shannon-Wiener Evenness indicated that abundances were moderately well distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a more balanced and less tolerant community than the upstream station.

Downstream Honey Branch Station (Mouth of Honey Branch)

A total of 306 individuals comprising 19 taxa were collected (Tables 2A and 7). Five pollution

sensitive (intolerant) taxa comprising 10.8% of the station's abundance were present. The sensitive caddisfly Family: Philopotamiidae contributed 5.2% to the total abundance at this station. Seven facultative (intermediate tolerance) taxa were present comprising 20.6% of the sample. The facultative caddisfly Family: Hydropsychidae accounted for 8.5% of the station's abundance. Seven tolerant taxa were present comprising 68.6% of the abundance at this station at the Mouth of Honey Branch. The tolerant midge, Chironomidae, accounted for 28.1% of the total abundance, and was the most abundant taxa of aquatic insect present. Nine EPT groups (Table 3A) were present which again aided the EPT:Chironomidae Index in being very desirable. All functional feeding groups were present and were well represented. A wide variety of mayflies, stoneflies, and caddisflies were collected at this station. The Simpson's and Shannon-Wiener Diversity Indices reflected a community moderately-high in diversity, and the Shannon-Wiener Evenness indicated that abundances were well distributed among the taxa, or heterogeneous. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a pollution tolerant, but healthy macroinvertebrate community with a very good periphyton community composition.

Upstream East Fork of Twelvepole Creek

A total of 1,800 individuals comprising 18 taxa were collected (Tables 2A and 8). Five pollution sensitive (intolerant) taxa comprising 37.6% of the station's abundance were present. The sensitive beetle Family: Elmidae contributed 15.8% to the total abundance at this station on the East Fork of Twelvepole Creek. Nine facultative (intermediate tolerance) taxa were present comprising 17.8% of the sample. The facultative mayfly Isonychia (Family: Oligoneuridae) accounted for 5.8% of the station's abundance, and was a significant contributor to the station. Four tolerant taxa were present comprising 44.7% of the abundance at this station above the confluence with Honey Branch. The tolerant midge, Chironomidae, accounted for 27.6% of the total abundance, and was once again the most abundant Family of aquatic insect present. Ten EPT groups (Table 3A) were present which again aided the EPT:Chironomidae Index in being very desirable. All functional feeding groups were present and were very well represented. Again, a wide variety of mayflies, stoneflies, and caddisflies were collected at this station. The Simpson's and Shannon-Wiener Diversity Indices reflected a community moderately-high in diversity; the Shannon-Wiener Evenness indicated that abundances were moderately well distributed among the taxa, or heterogeneous. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a slightly unbalanced, but healthy macroinvertebrate community.

Downstream East Fork of Twelvepole Creek

A total of 1,244 individuals comprising 14 taxa were collected (Tables 2A and 9). Five pollution sensitive (intolerant) taxa comprising 31.8% of the station's abundance were present. The sensitive mayfly Stenonema (Family: Heptageniidae) contributed 10.5% to the total abundance at this station on the East Fork of Twelvepole Creek. Only two facultative

(intermediate tolerance) taxa were present comprising 3.5% of the sample. The facultative caddisfly Family: Hydropsychidae accounted for 2.6% of the station's abundance. Seven tolerant taxa were present comprising 64.7% of the abundance at this station below the confluence with Honey Branch. The tolerant midge, Chironomidae, accounted for 53.4% of the total abundance, and was once again the most abundant Family of aquatic insect present. Five EPT groups (Table 3A) were present which again aided the EPT:Chironomidae Index in being moderately desirable. All functional feeding groups were present and were very well represented. A wide variety of mayflies were collected at this station; stoneflies and caddisflies were not very well represented. The Simpson's and Shannon-Wiener Diversity Indices reflected a community with moderate diversity; the Shannon-Wiener Evenness indicated that abundances were moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a somewhat unbalanced, but fairly healthy macroinvertebrate community.

Honey Branch's Middle Pond (Number 2)

A total of 2,720 individuals comprising 9 taxa were collected (Tables 2B and 10). Only one pollution sensitive (intolerant) taxa was present, the mayfly, Ephemera (Family: Ephemeridae), which contributed 1.2% to the total abundance of this pond. Two facultative (intermediate tolerance) taxa were present comprising 7.1% of the sample. The facultative mayfly Baetis (Family: Baetidae) accounted for 4.7% of the site's abundance, and was a significant component to the site's community. Six tolerant taxa were present comprising 91.7% of the abundance at this site. The tolerant midge, Chironomidae, accounted for 55.9% of the total abundance, and was the most abundant taxa at this middle sediment pond on Honey Branch. Three EPT groups (Table 3B) were present which contributed to the EPT:Chironomidae Index in being fairly desirable. Again, no scrapers or collector/filterers were present, however, a moderate variety of mayflies were collected at this station. The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-low in diversity, and the Shannon-Wiener Evenness indicated that abundances were moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a very pollution tolerant benthic macroinvertebrate community.

Honey Branch's Lower Pond (Number 1)

A total of 1,392 individuals comprising 8 taxa were collected (Tables 2B and 11). No pollution sensitive (intolerant) taxa were present. Three facultative (intermediate tolerance) taxa were present comprising 13.8% of the sample. The facultative mayfly Caenis (Family: Caenidae) accounted for 9.2% of the site's abundance, and was a significant component to the site's community. Five tolerant taxa were present comprising 86.2% of the abundance at this site. The tolerant midge, Chironomidae, accounted for 49.4% of the total abundance, and was the most abundant taxa at this lower sediment control pond on Honey Branch. One EPT group (Table 3B) was present which helped to contribute to the EPT:Chironomidae Index. Again, no

scrapers or collector/filterers were present. Not a wide variety of mayflies were collected at this station (Caenis was the only taxa). The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-low in diversity, and the Shannon-Wiener Evenness indicated that abundances were moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a very pollution tolerant benthic macroinvertebrate community.

Honey Branch's Sediment Ditch

A total of 2,192 individuals comprising 8 taxa were collected (Tables 2B and 12). Only one pollution sensitive (intolerant) taxa was present, the beetle, Peltodytes (Family: Haliplidae), which contributed 1.6% to the total abundance of this sediment ditch. Two facultative (intermediate tolerance) taxa were present comprising 13.1% of the sample. The facultative mayfly Baetis (Family: Baetidae) accounted for 12.4% of the site's abundance, and was a significant component to the site's community. Five tolerant taxa were present comprising 85.3% of the abundance at this site. The tolerant midge, Chironomidae, accounted for 37.2% of the total abundance, and was the most abundant taxa at this sediment ditch on Honey Branch. One EPT group (Table 3B) was present which contributed to the EPT:Chironomidae Index in being fairly desirable. Again, no scrapers or collector/filterers were present, and only the one taxa of mayflies was collected at this station. The Simpson's and Shannon-Wiener Diversity indices reflected a community with moderate diversity, and the Shannon-Wiener Evenness indicated that abundances were moderately-well distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a pollution tolerant/facultative benthic macroinvertebrate community.

DISCUSSION

One-way analysis of variance (ANOVA) comparing the abundances of aquatic macroinvertebrates between the three stations sampled on Honey Branch concluded that abundances between the three sites were not statistically significantly (? = 0.05) different (F value = 1.82). In addition, a one-way ANOVA comparing the number of taxa of aquatic macroinvertebrates between the three stations on Honey Branch also concluded that there was no significant difference in the number of taxa collected between the three stations.

When comparing total abundances between these three stations sampled on Honey Branch (Table 2A), it is somewhat apparent that differences exist. As stated previously, these differences were not statistically different. The Upstream Station (Toe of the Valley Fill) contained the largest total abundance as well as a couple more taxa than the Middle and Downstream (Mouth) Stations. Habitat (Table 4A) was very generally excellent and also very similar between the three Honey Branch sites with the exception of bank stability and streamside cover, but these parameters were not limiting to the aquatic fauna. Water chemistry (Table 1A) was overall fairly desirable, but the stations on Honey Branch did have elevated levels of sulfates, hardness, dissolved solids, and some metals, although these levels were not considered too limiting as several sensitive taxa comprised of many individuals were collected. Influence from the sediment ponds located on Honey Branch was also not limiting to the stream macroinvertebrate populations as the Upstream Honey Branch station (above the sediment ponds) did not have significantly more desirable aquatic insect populations than the Downstream Honey Branch station which was located below all sediment ponds and valley fills. The Downstream site did have lower total abundances of aquatic insects, but percentages of sensitive and facultative groups actually increased at the downstream station compared to the upstream station. It is also very interesting to note that the total disturbed area of the Honey Branch watershed is 261.69 acres or 43% of the total watershed area. Because this is now considered to be a high percentage of total disturbed area within a watershed, one would expect that the Honey Branch stream stations would have had poorer macroinvertebrate communities. However, the three stations located on Honey Branch contained relatively healthy populations of aquatic insects. This is based on the macroinvertebrate data which depicted that many individuals were collected from a very large number of taxa. Samples were comprised of many EPT groups and individuals (Table 3A), and all functional feeding groups were present and were generally well represented. It is obvious that the loss of a portion of the headwater area of Honey Branch from valley fills has not eliminated nor negatively affected the macroinvertebrate community downstream as originally believed.

One-way analysis of variance (ANOVA) comparing the abundances of aquatic macroinvertebrates between the two stations sampled on the East Fork of Twelvepole Creek concluded that abundances between the two sites were not statistically significantly (? = 0.05) different (F value = 1.06). In addition, a one-way ANOVA comparing the number of taxa of aquatic macroinvertebrates between the two stations also concluded that there was no significant difference in the number of taxa collected between the two sites on the East Fork of Twelvepole Creek. This

observation is crucial, because it exemplifies that the discharge from Honey Branch is not having a negative impact on the aquatic insect abundances located on the East Fork of Twelvepole Creek.

When comparing total abundances and taxa between these two stations sampled on the East Fork of Twelvepole Creek (Table 2A), one can observe that a few differences exist. As stated previously, these differences were not statistically different. From the water chemistry data (Table 1A), one can observe that overall water quality at both the East Fork of Twelvepole Creek's stations was desirable with near neutral pH levels, desirable alkalinity, and low conductivity, acidity, hardness, solids, sulfates, and most metals. In general, the downstream station on the East Fork of Twelvepole Creek had higher levels of most chemical constituents, but none were considered limiting to the aquatic fauna. These higher levels was obviously from the discharge of Honey Branch. From the habitat data (Table 4A), the downstream station on the East Fork had more desirable substrates as well as a better representation of riffle areas. There was, however, a shift in the community from one comprised of fairly equal percentages of sensitive and tolerant individuals at the upstream station, to one comprised of many more tolerant than sensitive individuals at the downstream station. This shift is undoubtably a factor of the water chemistry from Honey Branch. Although total abundances and total taxa are not significantly affected from the discharge, the water chemistry is affecting the composition of the macroinvertebrate community downstream. Nevertheless, both of the East Fork of Twelvepole Creek stations were considered healthy because they were comprised of a large number of taxa consisting of large abundances of aquatic insects. They both contained large numbers of sensitive individuals from several taxa. Both stations also contained wide varieties and large abundances of mayflies, stoneflies, and caddisflies (Table 3A).

The two stations located on the East Fork of Twelvepole Creek were not statistically compared to the stations located on Honey Branch because the streams represent different order (size) streams (the East Fork of Twelvepole Creek is at least 3rd order at the confluence with Honey Branch; Honey Branch is 1st order). With different order or stream sizes comes automatic differences in habitat (Table 4A), water quality/chemistry (Table 1A), and benthic macroinvertebrate communities (Table 2A).

The two ponds studied on Honey Branch (Pond Number 2 and Pond Number 1) contained large and low total numbers of aquatic insects, respectively. They both, however, contained relatively low numbers of taxa even though they were the older, more established structures (completion dates in 1988). This may have been due to the somewhat high pH levels, the more alkaline waters, or the elevated sulfates, magnesium, and/or chloride levels. The sediment ditch on Honey Branch contained a relatively large abundance of aquatic insects as well as a moderate number of taxa. No single chemical parameter or habitat parameter appeared limiting with the exception of the low dissolved oxygen level of 2.57 (Table 1B).

In general, the ponds and sediment control ditch on Honey Branch were well represented by the groups of aquatic insects which are normally present in these lentic type habitats. The functional feeding groups scrapers and collector/filterers were not present (Table 3B), but this was not surprising

since scrapers need silt-free environments for them to feed on the periphyton that attaches to rock substrates, and since the collector/filterers require faster-moving water in order to feed on the small particles of food which collected on constructed silken nets or on hairs on their bodies. The shredder functional feeding group (those that shred and consume leaves and other detrital materials) was also not well represented, but this group is also considered to be sensitive to disturbances and pollution. Generally, the sites were comprised mostly of tolerant organisms such as midges, dragonflies, and aquatic worms (Table 2B). As stated previously, this was to be expected, and was representative of aquatic insects which thrive in pond-type habitats.

If constructed properly, these sediment control ponds and sediment ditches can do a splendid job in removing solids and other water contaminants both by filtration and by precipitation prior to reaching downstream areas. They also provide aquatic habitats for countless abundances of aquatic insects, amphibians, reptiles, waterfowl, terrestrial wildlife, and potentially even fish. It should be pointed out that prior to mining, there was very little wetland habitat available on Honey Branch. Now, with the construction of the three sediment control ponds and the sediment ditch, several acres of open water as well as the subsequent wetland areas surrounding each pond and the sediment ditch have been added to the area. In addition, prior to mining, Honey Branch consisted of about 1,500 feet of intermittent stream. Now, there is approximately 1-2 miles of drainage ditches and main stream channel present, and but with the ponds available, total water surface area is considerably greater. The ponds studied for this report, undoubtably, provide an additional facet to the aquatic and semi-aquatic fauna currently found in area.

These sedimentation ponds can easily be converted into aesthetic, attractive, and usable wildlife features with very few modifications. For example, trees felled into the pond add both food and habitat for many species of aquatic insects. Additional structures can be placed in the ponds to provide hiding habitat for lentic fish species such as sunfish and bass. These structures also provide a refuge for both fish and insects, act as a breeding ground for many species of insects as well as some fish. Although prohibited from planting permanent, larger-growing vegetation such as trees around structures which are considered temporary, changes in management design could take place if these structures were to be considered as a permanent, and additional habitat for the area. Tall grasses, shrubs, and willow saplings, as well as larger trees could then be planted surrounding the pond to provide both a food source from fallen leaves/sticks and shade along shoreline areas.

If one compares this study to the previous conducted studies, several comparisons can be made. At the Upstream Honey Branch site (Toe of the Valley fill), during the SAIC Study (1998), only 41 organisms were collected from six taxa. Twenty-nine were isopods, leaving only 12 listed as being in the Class Insecta. There were seven EPT individuals from two taxa. During the Heer, Inc. sampling (1987), only six organisms from four taxa were collected. There were no common taxa present between the 1987 or 1998 studies. From Table 2A, during the current study, there were 626 individuals from 22 taxa collected. At the Middle Honey Branch site, during the SAIC Study, 172 individuals from 14 taxa (6 EPT taxa) were collected. During the Heer, Inc. Study, no organisms were

collected at this site. From Table 2A, there were 558 individuals from 21 taxa (8 EPT taxa) collected. At the Downstream Honey Branch site (Mouth of Honey Branch), during the 1998 SAIC Study, 154 individuals from eleven taxa (4 EPT taxa) were collected. During the 1987 Heer, Inc. Study, 22 individuals from seven taxa (4 EPT taxa) were collected at the mouth of Honey Branch. During the current study, 306 individuals from 19 taxa (including 9 EPT taxa) were collected (Tables 2A and 3A). At the Downstream East Fork of Twelvepole Creek station, during the SAIC Study, 154 individuals from 16 taxa (9 EPT taxa) were collected. During the Heer, Inc. Study, 15 organisms from 6 taxa (1 EPT taxa) were collected. From this current study, 1,244 individuals from 14 taxa (5 EPT taxa) were collected at the downstream station on the East Fork of Twelvepole Creek.

Presumably, no upstream station on the East Fork of Twelvepole Creek was sampled during the SAIC and the Heer, Inc. Studies. Therefore, no determination on possible effects on East Fork's downstream station from Honey Branch's discharge could not be made. From the water chemistry data from the SAIC Study, iron levels are very similar; manganese levels have increased at the Upstream and Middle Honey Branch sites; TSS levels are similar; chloride levels are similar on Honey Branch, but have increased on the East Fork of Twelvepole Creek; magnesium levels are similar on Honey Branch, but have increased on the East Fork of Twelvepole Creek; calcium levels are similar on Honey Branch, but have increased on the East Fork of Twelvepole Creek; and sodium levels have increased at all sites. Most of these increases are most likely not significant, and are believed to be non-limiting as overall benthic macroinvertebrate results have become more desirable since the 1998 study. Even though overall tolerance levels determined for the current study depict more tolerant communities at each site than depicted from the previous studies, caution should be used here since the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) were based on much smaller total numbers of individuals and very few taxa.

CONCLUSIONS

Influence from the sediment ponds located on Honey Branch was also not limiting to the stream macroinvertebrate populations as the Upstream Honey Branch station (above the sediment ponds) did not have significantly more desirable aquatic insect populations than the Downstream Honey Branch station which was located below all sediment ponds and valley fills. The Downstream site did have lower total abundances of aquatic insects, but percentages of sensitive and facultative groups actually increased at the downstream station compared to the upstream station. It is also very interesting to note that the total disturbed area of the Honey Branch watershed is 261.69 acres or 43% of the total watershed area. Because this is now considered to be a high percentage of total disturbed area within a watershed, one would expect that the Honey Branch stream stations would have had poorer macroinvertebrate communities. However, the three stations located on Honey Branch contained relatively healthy populations of aquatic insects. This is based on the macroinvertebrate data which depicted that many individuals were collected from a very large number of taxa. The stations contained a wide variety of stoneflies, mayflies, and caddisflies, and were represented by all functional feeding groups. Of the physical and chemical water quality parameters analyzed at the Honey Branch locations, none were considered too limiting, although several were considered to be elevated. Food inputs were readily available, and habitat was considered excellent at each location due to the surrounding forest, which obviously contributed to the desirable aquatic macroinvertebrate communities inhabiting Honey Branch. It is obvious that the loss of a portion of the headwater area of Honey Branch from valley fills has not eliminated nor negatively affected the macroinvertebrate community downstream as originally believed.

Overall, the benthic macroinvertebrate populations found at the two stations located on the East Fork of Twelvepole Creek were considered to be healthy because they were comprised of communities containing a very wide variety of taxa and very large abundances of individuals. They also were comprised of many sensitive and facultative individuals represented by several taxa. Both stations contained a wide variety of mayflies; stoneflies and caddisflies were less represented at the downstream East Fork station. All functional feeding groups were present and were well represented at both stations. Of the physical and chemical water quality parameters analyzed at both locations, none were considered limiting, although the effects from Honey Branch entering the East Fork of Twelvepole Creek were observable in the water chemistry data. There was also a shift towards a more tolerant community at the downstream East Fork station. Nevertheless, both stations contained desirable benthic macroinvertebrate communities which was a result of the good water quality, desirable habitat, and available food inputs.

In general, the ponds and sediment control ditch on Honey Branch were well represented by the groups of aquatic insects which are normally present in these lentic type habitats. The functional feeding groups scrapers and collector/filterers were not present, but this was not surprising since scrapers need silt-free environments for them to feed on the periphyton that attaches to rock substrates, and since the collector/filterers require faster-moving water in order to feed on the small particles of

food which collected on constructed silken nets or on hairs on their bodies. The shredder functional feeding group (those that shred and consume leaves and other detrital materials) was also not well represented, but this group is also considered to be sensitive to disturbances and pollution. Generally, the sites were comprised mostly of tolerant organisms such as midges, dragonflies, and aquatic worms. As stated previously, this was to be expected, and was representative of aquatic insects which thrive in pond-type habitats.

Much greater abundances as well as more taxa of aquatic insects were collected during this study compared to previous studies conducted at the same locations. Some of the levels of water chemistry constituents have remained similar; others have increased, but not to limiting levels, and mostly on the East Fork of Twelvepole Creek. Some shifts towards more tolerant communities may have occurred since the previous studies, but caution should be used since the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) were based on much smaller total numbers of individuals and very few taxa.

APPENDIX A

APPENDIX B

TABLE 1A. Physical and chemical water-quality variables for stream stations on Honey Branch and on Twelvepole Creek, above and below confluence with Honey Branch, 08 October 1999.

PARAMETER	Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
Flow (ft^3/s)	0.15	0.08	0.11	0.11	0.21
Temperature (?C)	13.36	14.41	16.29	13.88	14.77
Dissolved Oxygen (mg/l)	6.82	7.74	6.64	4.69	6.56
pH (SI units)	6.60	7.91	7.92	7.16	7.50
Conductivity (? mhos)	400	367	348	159	212
Acidity (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	138	126	123	85.1	93.7
Chloride (mg/l)	3.5	3.8	3.5	12.0	9.3
Hardness (mg/l)	303	284	267	87	137
Sulfate (mg/l)	188	167	152	28.2	66.3
TDS (mg/l)	412	418	358	166	218
TSS (mg/l)	3	2	3	14	6
Fecal Coliform (#/100ml)	23	14	4	150	110
Aluminum (mg/l)	0.109	0.116	0.076	0.130	0.102
Antimony (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic (mg/l)	0.002	<0.002	<0.002	0.003	<0.002
Barium (mg/l)	0.033	0.030	0.040	0.045	0.043
Beryllium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/l)	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Calcium (mg/l)	53.4	49.6	48.1	20.9	28.9
Chromium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005
Iron (mg/l)	0.370	0.358	0.060	0.481	0.316
Lead (mg/l)	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (mg/l)	41.2	38.8	35.7	8.46	15.7
Manganese (mg/l)	0.255	0.139	0.026	0.068	0.046
Mercury (mg/l)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (mg/l)	<0.030	<0.030	<0.030	<0.030	<0.030
Selenium (mg/l)	<0.003	<0.003	<0.003	<0.003	<0.003
Silver (mg/l)	<0.004	<0.004	<0.004	<0.004	<0.004
Sodium (mg/l)	7.86	7.35	6.88	10.7	9.95
Thallium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (mg/l)	0.004	0.009	0.003	0.016	<0.002

TABLE 1B. Physical and chemical water-quality variables for Honey Branch sediment control ponds

and ditch, 08 October 1999.

PARAMETER	Middle Honey Branch Pond (1988)	Lower Honey Branch Pond (1988)	Honey Branch Sediment Ditch (1988)
Temperature (?C)	11.83	16.71	11.29
Dissolved Oxygen (mg/l)	10.34	7.25	2.57
BOD (mg/l)	<2	<2	3
pH (SI units)	8.19	7.87	6.67
Conductivity (? mhos)	357	342	450
Acidity (mg/l)	<1.0	<1.0	<1.0
Alkalinity (mg/l)	122	121	94.6
Chloride (mg/l)	3.9	3.8	2.4
Hardness (mg/l)	280	268	349
Sulfate (mg/l)	167	161	274
TDS (mg/l)	324	381	501
TSS (mg/l)	3	<1	11
Fecal Coliform (#/100ml)	105	6	9
Aluminum (mg/l)	0.064	0.125	0.070
Antimony (mg/l)	<0.001	<0.001	<0.001
Arsenic (mg/l)	<0.002	<0.002	<0.002
Barium (mg/l)	0.028	0.035	0.019
Beryllium (mg/l)	<0.001	<0.001	<0.001
Cadmium (mg/l)	<0.0003	<0.0003	<0.0003
Calcium (mg/l)	49.1	47.3	68.2
Chromium (mg/l)	<0.001	<0.001	<0.001
Copper (mg/l)	<0.005	0.012	<0.005
Iron (mg/l)	0.307	0.275	0.130
Lead (mg/l)	<0.002	<0.002	<0.002
Magnesium (mg/l)	38.3	36.3	43.4
Manganese (mg/l)	0.154	0.126	0.165
Mercury (mg/l)	<0.0002	<0.0002	<0.0002
Nickel (mg/l)	<0.030	<0.030	<0.030
Selenium (mg/l)	<0.003	<0.003	<0.003
Silver (mg/l)	<0.004	<0.004	<0.004
Sodium (mg/l)	8.06	7.78	8.98
Thallium (mg/l)	<0.001	<0.001	<0.001
Zinc (mg/l)	<0.002	0.010	0.002

TABLE 2A. Total abundances of benthic macroinvertebrates collected via Surber and Kick-net samples from stream stations on Honey Branch and Twelvepole Creek, above and below confluence with Honey Branch, 08 October 1999.

	STATION				
TAXON	Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
Insecta					
Ephemeroptera (Mayflies)					
Ameletidae					
Ameletus (F)		8	12		
Baetidae					
Baetis (F)				36	
Baetiscidae					
Baetisca (S)				68	126
Caenidae					
Caenis (S)				76	30
Ephemerellidae					
Ephemerella (F)			2	12	
Heptageniidae					
Stenonema (S)			1	244	130
Leptophlebiidae					
Leptophlebia (S)	34				
Oligoneuridae					
Isonychia (F)				104	
Plecoptera (Stoneflies)					
Capniidae (S)			2		8
Chloroperlidae (S)	4	4	6		
Leuctridae					
Leuctra (F)	2	56	4	36	
Perlidae (S)	1				
Perlodidae (F)	3	12			
Taeniopterygidae (F)	2			16	
Trichoptera (Caddisflies)					
Hydropsychidae (F)	2	26	26	88	32
Lepidostomatidae					
Lepidostoma (S)	2				
Limnephilidae (F)		4			
Philopotamiidae (S)		16	16		
Polycentropodidae (F)	8	4	2		
Rhyacophilidae (F)	4			4	

TABLE 2A. Continued.

TAXON	STATION				
	Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
Diptera (True Flies)					
Ceratopogonidae (T)	38	8		28	24
Chaoboridae (T)		2			
Chironomidae (T)	148	148	86	496	664
Simuliidae (F)		4		20	
Stratiomyidae (T)		2			
Tabanidae (T)	8				
Tipulidae					
Dicranota (T)		2			
Hexatoma (T)	16			4	
Tipula (T)		2	4		2
Coleoptera (Beetles)					
Elmidae (S)	1	78	8	284	102
Psephenidae (S)				4	
Saldidae (S)	1	2			
Hemiptera (Water Bugs)					
Corixidae (T)	2				
Odonata (Dragonflies)					
Coenagrionidae (T)_					2
Cordulegastridae					
Cordulegaster (T)					5
Gomphidae (T)	2		13		
Hagenius (T)			16		
Lanthus (T)			20		
Megaloptera (Hellgrammites)					
Corydalidae					
Corydalus (S)		2			
Collembola (Springtails) (F)	22	2	2		
Oligochaeta (Aquatic Worms) (T)	320	156	69	276	104
Planaridae (Flatworms) (T)	4	8	2		4
Crayfish (F)	2	12	15	4	11

TABLE 2A. Continued.

TAXON	STATION Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
salamander larvae* (U)	1				
clams* (U)				16	16
snails* (U)				4	
Johnny darter* (U)				1	
Total Individuals	626	558	306	1,800	1,244
Taxa	22	21	19	18	14
Sensitive Ind. (%)	43 (6.9)	102 (18.3)	33 (10.8)	676 (37.6)	396 (31.8)
Sensitive Taxa	5	5	5	5	5
Facultative Ind. (%)	45 (7.2)	128 (22.9)	63 (20.6)	320 (17.8)	43 (3.5)
Facultative Taxa	9	8	7	9	2
Tolerant Ind. (%)	538 (85.9)	328 (58.8)	210 (68.6)	804 (44.7)	805 (64.7)
Tolerant Taxa	8	8	7	4	7

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 2B. Total abundances of benthic macroinvertebrates collected via Ponar grab samples taken from Honey Branch sediment control ponds and sediment ditch at the Pen Coal Corporation, 08 October 1999.

TAXON	Middle Honey Branch Pond (1988)	Lower Honey Branch Pond (1988)	Honey Branch Sediment Ditch (1988)
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	128		272
Caenidae			
Caenis (F)	64	128	
Ephemeridae			
Hexagenia (S)	32		
Diptera (True Flies)			
Ceratopogonidae (T)	624	384	800
Chironomidae (T)	1520	688	816
Tipulidae			
Tipula (T)	32		
Coleoptera (Beetles)			
Dytiscidae (T)			16
Haliplidae			
Peltodytes (T)			32
Odonata (Dragonflies)			
Coenagrionidae (T)	16	16	48
Corduliidae			
Cordulia (T)	16	16	
Collembola (F)		48	16
Oligochaeta (Aquatic worms) (T)	288	96	192
Crayfish (F)		16	
clams* (U)	16	208	
Total Individuals	2,720	1,392	2,192
Total Taxa	9	8	8

TABLE 2B. Continued

	Middle Honey Branch Pond (1988)	Lower Honey Branch Pond (1988)	Honey Branch Sediment Ditch (1988)
Sensitive Ind. (%)	32 (1.2)	0 (0.0)	32 (1.6)
Number of Taxa	1	0	1
Facultative Ind. (%)	192 (7.1)	192 (13.8)	288 (13.1)
Number of Taxa	2	3	2
Tolerant Ind. (%)	2,496 (91.7)	1,200 (86.2)	1,872 (85.3)
Number of Taxa	6	5	5

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 3A. Selected benthic macroinvertebrate metrics for stations on Honey Branch and stations on Twelvepole Creek, above and below confluence with Honey Branch, 08 October 1999.

METRIC	Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
Taxa Richness	22	21	19	18	14
Modified Hilsenhoff Biotic Index	5.46	4.77	4.57	4.76	5.26
Ratio of Scrapers to Collector/Filterers	2:2	80:46	9:42	532:212	232:32
Ratio of EPT:Chironomidae	62:148	130:148	71:86	684:496	326:664
% Contribution of Dominant Family	51.1% Oligochaeta	30.0% Oligochaeta	28.1% Chironomidae	27.6% Chironomidae	53.4% Chironomidae
EPT Index	10	8	9	10	5
% Shredders to Total	5.4%	13.3%	4.6%	2.9%	0.6%
Simpson's Diversity Index	0.67	0.82	0.85	0.85	0.68
Shannon-Wiener Diversity	2.33	3.01	3.27	3.14	2.32
Shannon-Wiener Evenness	0.52	0.68	0.77	0.75	0.61

TABLE 3B. Selected benthic macroinvertebrate metrics for the Honey Branch sediment control ponds and sediment ditch located at the Pen Coal Corporation, 08 October 1999.

METRIC	Middle Honey Branch Pond (1988)	Lower Honey Branch Pond (1988)	Honey Branch Sediment Ditch (1988)
Taxa Richness	9	8	8
Modified Hilsenhoff Biotic Index	6.06	6.11	5.82
Ratio of Scrapers to Collector/Filterers	0:0	0:0	0:0
Ratio of EPT:Chironomidae	224:1520	128:688	272:816
% Contribution of Dominant Family	55.9% Chiro.[1]	49.4% Chiro.[1]	37.2% Chiro.[1]
EPT Index	3	1	1
% Shredders to Total	0.0%	3.4%	0.7%
Simpson's Diversity Index	0.63	0.66	0.70
Shannon-Wiener Diversity	1.91	1.99	2.06
Shannon-Wiener Evenness	0.58	0.66	0.69

1 = Diptera: Chironomidae

TABLE 4A. Habitat scores for the stations on Honey Branch and stations on Twelvepole Creek, above and below confluence with Honey Branch, 08 October 1999.

	Upstream Honey Branch	Midstream Honey Branch	Mouth Honey Branch	Upstream Twelvepole Creek	Downstream Twelvepole Creek
Primary - Substrate and Instream Cover					
1. Bottom Substrate and Available Cover (0-20)	18	18	18	14	17
2. Embeddedness (0-20)	18	19	16	16	17
3. Flow/Velocity (0-20)	16	18	18	10	16
Secondary - Channel Morphology					
4. Channel Alterations (0 - 15)	12	14	10	14	12
5. Bottom Scouring and Deposition (0 - 15)	12	14	11	13	10
6. Pool/Riffle, Run/Bend Ratio (0 -15)	11	11	14	7	12
Tertiary - Riparian and Bank Structure					
7. Bank Stability (0 -10)	5	10	7	6	7
8. Bank Vegetation Stability (0 -10)	9	10	7	7	7
9. Streamside Cover (0 - 10)	8	5	6	7	7

Note: The scoring for each category	Excellent	Good	Fair	Poor
Primary	16 - 20	11 - 15	6 - 10	0 - 5
Secondary	12 - 15	8 - 11	4 - 7	0 - 3
Tertiary	9 - 10	6 - 8	3 - 5	0 - 2

TABLE 4B. Summary of habitat descriptions for the Honey Branch sediment control ponds and sediment ditch located at the Pen Coal Corporation, 08 October 1999.

	Middle Honey Branch Pond (1988)	Lower Honey Branch Pond (1988)	Honey Branch Sediment Ditch (1988)
Pond/Ditch Surface Acreage	0.53	1.01	0.05
Length x Width (feet)	150 X 150	500 X 300	100 X 20
Bottom Substrate Type	silty, detrital	silty, detrital	all organic
Bank Stability	stable	fairly stable	very stable
Bank Vegetation Stability	100% vegetated	100% vegetated	100% vegetated
Vegetation Types	grasses, shrubs, herbaceous plants, filamentous algae, submerged & emergent aquatics	grasses, shrubs, herbaceous plants, filamentous algae, submerged & emergent aquatics	grasses, shrubs, herbaceous plants, filamentous algae, submerged & emergent aquatics
Pond/Ditch Cover	some	none	some

TABLE 5. Abundances of benthic macroinvertebrates collected per sample from the Upstream Honey Branch Station, Toe of the Valley Fill, 08 October 1999.

	SAMPLE			
TAXON	Surber 1	Surber 2	Surber 3	Kick
Insecta				
Ephemeroptera (Mayflies)				
Leptophlebiidae				
Leptophlebia (S)				34
Plecoptera (Stoneflies)				
Chloroperlidae (S)	4			
Leuctridae				
Leuctra (F)	2			
Perlidae (S)	1			
Perlodidae (F)	1			2
Taeniopterygidae (F)	2			
Trichoptera (Caddisflies)				
Hydropsychidae (F)	2			
Lepidostomatidae				
Lepidostoma (S)			2	
Polycentropodidae (F)		4		4
Rhyacophilidae (F)			4	
Diptera (True Flies)				
Ceratopogonidae (T)	2		4	32
Chironomidae (T)	12	40	24	72
Tabanidae (T)		4		4
Tipulidae				
Hexatoma (T)	2	8	4	2
Coleoptera (Beetles)				
Elmidae (S)	1			
Saldidae (S)	1			
Hemiptera (Water Bugs)				
Corixidae (T)				2
Odonata (Dragonflies)				
Gomphidae (T)				2
Collembola (Springtails) (F)	2	8	8	4
Oligochaeta (Aquatic Worms) (T)	28	204	64	24

TABLE 5. Continued.

TAXON	SAMPLE Surber 1	Surber 2	Surber 3	Kick
Planaridae (Flatworms) (T)		4		
Crayfish (F)				2
salamander larvae* (U)	1		1	
Total Individuals	60	272	110	184
Taxa	13	7	7	12

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 6. Abundances of benthic macroinvertebrates collected per sample from the Midstream Honey Branch Station, 08 October 1999.

TAXON	SAMPLE Surber 1	Surber 2	Surber 3	Kick
Insecta				
Ephemeroptera (Mayflies)				
Ameletidae				
Ameletus (F)		8		
Plecoptera (Stoneflies)				
Chloroperlidae (S)	4			
Leuctridae				
Leuctra (F)		56		
Perlodidae (F)	2		10	
Trichoptera (Caddisflies)				
Hydropsychidae (F)	4	20		2
Limnephilidae (F)		4		
Philopotamidae (S)		16		
Polycentropodidae (F)	2	2		
Diptera (True Flies)				
Ceratopogonidae (T)			4	4
Chaoboridae (T)				2
Chironomidae (T)	48	32	56	12
Simuliidae (F)		4		
Stratiomyidae (T)			2	
Tipulidae				
Dicranota (T)	2			
Tipula (T)	2			
Coleoptera (Beetles)				
Elmidae (S)	38	24	6	6
Saldidae (S)	2			
Megaloptera (Hellgrammites)				
Corydalidae				
Corydalus (S)	2			
Collembola (Springtails) (F)			2	
Oligochaeta (Aquatic Worms) (T)	20	16	76	44
Planaridae (Flatworms) (T)	4	4		

Crayfish (F)	2	2	2	6

TABLE 6. Continued.

	SAMPLE			
	Surber 1	Surber 2	Surber 3	Kick
Total Individuals	132	192	158	76
Taxa	13	12	8	7

( ) Classification of Pollution Indicator Organisms
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TABLE 7. Abundances of benthic macroinvertebrates collected per sample from the Downstream Honey Branch Station, Mouth of Honey Branch, 08 October 1999.

	SAMPLE			
TAXON	Surber 1	Surber 2	Surber 3	Kick
Insecta				
Ephemeroptera (Mayflies)				
Ameletidae				
Ameletus (F)	4	4	4	
Ephemerellidae				
Ephemerella (F)		2		
Heptageniidae				
Stenonema (S)		1		
Plecoptera (Stoneflies)				
Capniidae (S)		2		
Chloroperlidae (S)	6			
Leuctridae				
Leuctra (F)				4
Trichoptera (Caddisflies)				
Hydropsychidae (F)	6	14	6	
Philopotamidae (S)	6	2	8	
Polycentropodidae (F)			2	
Diptera (True Flies)				
Chironomidae (T)	34	14	14	24
Tipulidae				
Tipula (T)				4
Coleoptera (Beetles)				
Elmidae (S)	4	2	2	
Odonata (Dragonflies)				
Gomphidae (T)	4	1		8
Hagenius (T)				16
Lanthus (T)				20
Collembola (Springtails) (F)			2	
Oligochaeta (Aquatic Worms) (T)	12	9	20	28
Planaridae (Flatworms) (T)			2	
Crayfish (F)		1	2	12

TABLE 7. Continued.

	SAMPLE			
	Surber 1	Surber 2	Surber 3	Kick
Total Individuals	76	52	62	116
Taxa	8	11	10	8

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 8. Abundances of benthic macroinvertebrates collected per sample from the Upstream Twelvepole Creek Station, Above confluence with Honey Branch, 08 October 1999.

TAXON	SAMPLE			
	Surber 1	Surber 2	Surber 3	Kick
Insecta				
Ephemeroptera (Mayflies)				
Baetidae				
Baetis (F)	16	12		8
Baetiscidae				
Baetisca (S)	24	20	16	8
Caenidae				
Caenis (S)	12	28	24	12
Ephemerellidae				
Ephemerella (F)	12			
Heptageniidae				
Stenonema (S)	68	124	32	20
Oligoneuriidae				
Isonychia (F)	16	56	32	
Plecoptera (Stoneflies)				
Leuctridae				
Leuctra (F)	8	16	8	4
Taeniopterygidae (F)		16		
Trichoptera (Caddisflies)				
Hydropsychidae (F)	12	20	52	4
Rhyacophilidae (F)	4			
Diptera (True Flies)				
Ceratopogonidae (T)			20	8
Chironomidae (T)	120	128	192	56
Simuliidae (F)	4	16		
Tipulidae				
Hexatoma (T)				4
Coleoptera (Beetles)				
Elmidae (S)	60	96	80	48
Psephenidae (S)	4			
Oligochaeta (Aquatic Worms) (T)	40	120	56	60
Crayfish (F)				4

TABLE 8. Continued.

	SAMPLE			
	Surber 1	Surber 2	Surber 3	Kick
clam* (U)	4	4	8	
snail* (U)		4		
Johnny darter* (U)		1		
Total Individuals	400	652	512	236
Taxa	14	12	10	12

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
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TABLE 9. Abundances of benthic macroinvertebrates collected per sample from the Downstream Twelvepole Creek Station, Below confluence with Honey Branch, 08 October 1999.

	SAMPLE			
TAXON	Surber 1	Surber 2	Surber 3	Kick
Insecta				
Ephemeroptera (Mayflies)				
Baetiscidae				
Baetisca (S)	64	26	20	16
Caenidae				
Caenis (S)	12	4	6	8
Heptageniidae				
Stenonema (S)	28	14	32	56
Plecoptera (Stoneflies)				
Capniidae (S)	4	4		
Trichoptera (Caddisflies)				
Hydropsychidae (F)	8		24	
Diptera (True Flies)				
Ceratopogonidae (T)	20		4	
Chironomidae (T)	404	92	132	36
Tipulidae				
Tipula (T)			2	
Coleoptera (Beetles)				
Elmidae (S)	16	24	20	42
Odonata (Dragonflies)				
Coenagrionidae (T)				2
Cordulegastridae				
Cordulegaster (T)			2	3
Oligochaeta (Aquatic Worms) (T)	52	20	24	8
Planaridae (Flatworms) (T)	4			
Crayfish (F)		4	2	5
clam* (U)	4		8	4
Total Individuals	612	188	268	176
Taxa	10	8	11	9

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms

(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 10. Abundances of benthic macroinvertebrates collected per sample from Middle Honey Branch Pond (Pond Number 2), 08 October 1999.

	SAMPLE		
TAXON	Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	96	16	16
Caenidae			
Caenis (F)			64
Ephemeridae			
Hexagenia (S)	32		
Diptera (True Flies)			
Ceratopogonidae (T)	320	160	144
Chironomidae (T)	896	240	384
Tipulidae			
Tipula (T)	32		
Odonata (Dragonflies)			
Coenagrionidae (T)			16
Corduliidae			
Cordulia (T)			16
Oligochaeta (Aquatic Worms) (T)	128	112	48
clams* (U)			16
Total Individuals	1504	528	688
Taxa	6	4	7

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
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TABLE 11. Abundances of benthic macroinvertebrates collected per sample from Lower Honey Branch Pond (Pond Number 1), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Caenidae			
Caenis (F)	64		64
Diptera (True Flies)			
Ceratopogonidae (T)	96	256	32
Chironomidae (T)	192	192	304
Odonata (Dragonflies)			
Coenagrionidae (T)	16		
Corduliidae			
Cordulia (T)	16		
Collembola (Springtails) (F)	48		
Oligochaeta (Aquatic Worms) (T)	96		
Crayfish (F)	16		
clams* (U)	80	64	64
Total Individuals	544	448	400
Taxa	8	2	3

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 12. Abundances of benthic macroinvertebrates collected per sample from Honey Branch Sediment Ditch, 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	112	64	96
Diptera (True Flies)			
Ceratopogonidae (T)	288	320	192
Chironomidae (T)	208	320	288
Coleoptera (Beetles)			
Dytiscidae (T)	16		
Haliplidae			
Peltodytes (S)			32
Odonata (Dragonflies)			
Coenagrionidae (T)	16	32	
Collembola (Springtails) (F)	16		
Oligochaeta (Aquatic Worms) (T)		64	128
Total Individuals	656	800	736
Taxa	6	5	5

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

APPENDIX C

Photograph 1. Upstream Honey Branch (Toe of Valley Fill) Station.

Photograph 2. Upstream Honey Branch (Toe of Valley Fill) Station.

Photograph 3. Middle Honey Branch Station.

Photograph 4. Middle Honey Branch Station.

Photograph 5. Middle Honey Branch Pond (Pond Number 2).

Photograph 6. Lower Honey Branch Pond (Pond Number 1).

Photograph 7. Honey Branch Sediment Ditch.

Photograph 8. Honey Branch Sediment Ditch.